ONLINE INTERACTIVE PLATFORM FOR INFORMING TOURISTS ABOUT POINTS OF INTEREST, ACCESSIBILITY AND POTENTIAL RISKS ON MOUNTAIN TOURIST ROUTES

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Abstract

In recent years, the popularity of hiking has grown constantly in different categories of the population. Although hiking offers benefits for physical and mental health, knowledge of the areas visited is essential to avoid certain risks. Clear information about mountain trails is necessary for any visitor. Due to technological developments and smartphones equipped with GPS, paper maps are slowly forgotten. In these maps there is no information about the current state of the routes or facilities in the area. **The aim of this paper is to create and present an online interactive mapping application that allows the user's spatial location with the GPS on the smartphone, display and navigate tourist routes and other points of interest such as accommodation, camping areas, springs or other objectives.** Through the OpenStreetMap database and the Mapbox library we can obtain, filter and display data as desired by the user on an interactive and dynamic map. The platform intends to promote outdoor physical activity and attract less experienced tourists to mountain areas. By creating a community that can communicate information about the status of trails, dangerous areas and other useful information immediately available to other users we want to facilitate the approach to these mountain areas. In the future, the platform will allow integration with other platforms for booking accommodation, communication between hiking enthusiasts and organizing trips. **In order to create the application, we extracted and processed data from OpenStreetMap for the entire Romanian territory, we compiled our own sets of data relevant for mountain tourism, which we made available in an application based on Vector Tiles Mapbox technology.**

Keywords: *interactive map, online, Mapbox, Vector Tiles, OpenStreetMap, community, web application*.
JEL Codes: Q26 (Recreational Aspects of Natural Resources), Z32 (Tourism and Development).

INTRODUCTION

In recent years, the popularity of hiking has steadily increased in different segments of the population. Although hiking offers benefits for physical and mental health, knowledge of the areas visited is essential to avoid certain risks.

The usual method of obtaining information about mountain trails are paper maps that contain information about all the elements of tourist interest in the mountain area presented. The use of these maps provides a clear picture of the area visited and studies show that traditional paper maps are more conducive to the acquisition of spatial knowledge than electronic maps (Dickmann, 2012).

However, the advent of mobile devices and the rapid advancement of technology has made another mapping information medium available to anyone: the smartphone. A smartphone provides quick access to data in various formats and contains a GPS device that can locate the user.

With the development of these smart mobile devices, new cartographic products and libraries have appeared that are able to offer a large part of the functionalities of a GIS product directly online, without the need to install a program.

In addition, a new phenomenon called Mass amateurization (Shirky, 2008) has allowed anyone to add useful information on the Internet. In the case of spatial information, the most popular platform where data is added by a community of non-professionals is OpenStreetMap (OSM). OSM is an example of so-called voluntary geographic information (VGI), which is an alternative to professionally collected geographic information (Goodchild, 2007).

This study presents the possibility to use the free data available online together with free libraries for the creation of interactive maps online to create an alternative map for mountain tourism.

The purpose of this map is to always provide up-to-date information on where a mountain visitor is. In order to benefit from the advantages of a digital mapping application, I will allow the interactive display of layers according to the user's desire and complex useful information about the points of interest displayed on the map.

LITERATURE REVIEW

Digital applications for tourism have been used in several projects and strategies to promote or modernize tourist areas (Jammet and Linder, 2019; Posti et al., 2014; Shaker et al., 2020), sometimes specifically dedicated to hiking (Hills & Thomas, 2019; Lindell, 2014; Walmsley and Crowe, 2016). Mountain tourism is one of the most popular activities targeted by such applications. Various projects have also implemented websites or digital platforms dedicated to hiking (Kuby et al., 2001; Traunmüller et al., 2013; Rogers et al., 2020). These applications or sites, as well as many others, help to inform any visitors of some areas through modern techniques. However, the mentioned applications are specific for certain areas and in Romania there is not yet a constantly updated online application with new information. In this study we want to combine various possibilities offered by the new web technologies mentioned for the promotion and popularization of mountain tourism in Romania in the form of an interactive web map.

DATA AND METHODS

There are several frequently used libraries for making online maps. Among the most popular are Leaflet, Google Maps API, Mapbox GL JS and Carto. Initially, these services used images to represent the data on the map. These small images called tiles were arranged as a grid on the map and contained various information depending on the scale of the map.

In this study we aimed to use the data already existing in the OSM and obtained from their analysis. OSM contains data on the entire surface of the Earth and objects on it, classified for almost any use. In case of use for an interactive tourist map we decided to organize and filter the relevant data and display them independently of the generic information on the map. This approach, which is possible using the vector tiles technology presented below, allows you to highlight objects or items of interest on a map and prioritize their display. The other elements remain on the map but are less visible, thus becoming ancillary information.

OSM provides data from the database in the form of structures called ways with attached attributes. Initially, OSM data was stored as XML files, and each structure had different attributes attached from a collection of valid attributes. Several ways that refer to the same

objects or elements in the field are grouped in the OSM as relations. A mountain trail is one such relation. In the case of mountain trails, the relations are composed of ways with attributes as shown in Figure 1.

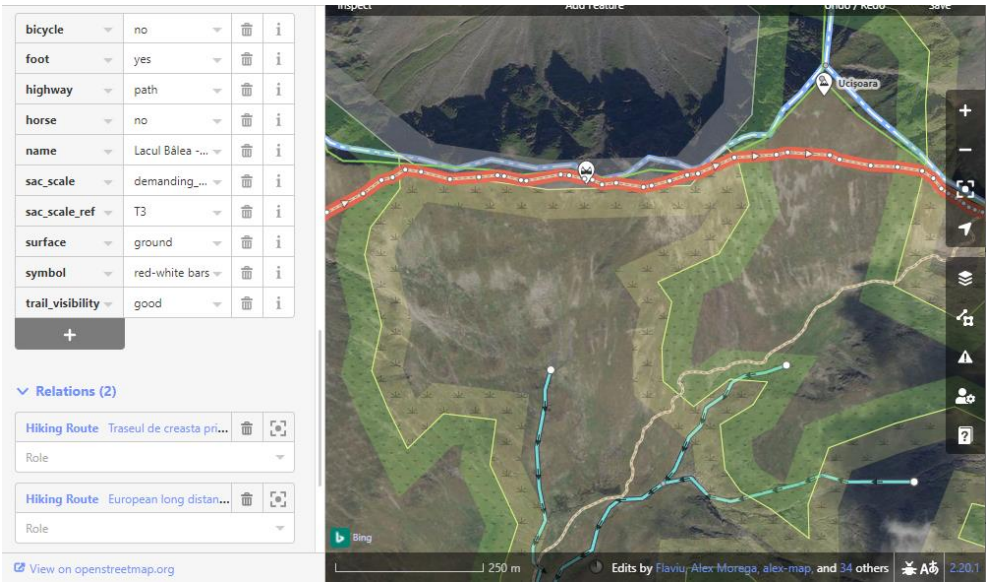

Fig. 1. Mountain trail data available in OpenStreetMap

Source: https://www.openstreetmap.org

In the 2010s, several companies made progress in developing open source vector tile technology. This technology allows the transmission of vector information in binary format and its dynamic drawing on the user's browser instead of displaying still images. Release of Mapbox Vector Tile Specification (Agafonkin et al., 2014) and Mapbox GL (Mapbox, 2014) initiated the advancement of this technology in open source solutions, other than the dominant commercial platforms for web maps. In 2015, Esri adopted the Mapbox Vector Tile Specification (Andrew Turner, 2015). Azure Maps, which was released to the public from Microsoft in 2018, uses Mapbox GL (Microsoft, 2018).

From a practical point of view, a vector tile transmits geographical data divided into approximately square areas of fixed size. They contain only pre-generated vector data that is present on the requested area. Vector tiles are rendered on the client's device with a style, which is a small text file that that describes the appearance of the map elements (MapTiler, 2019).

The Mapbox GL library offers the ability to use vector tiles to create styles on a complex online mapping platform. To create a map style suitable for mountain tourism we used a functionality offered by Mapbox called Mapbox Studio. This product allows the styling of OSM data according to its attributes and the creation of a map style from the grouping of the various types of structures.

Most of the elements displayed on the map belong to a classic map that is easy to view with the relief, roads and basic localities displayed in light colors. To obtain the desired

result, we isolated the mountain trails (Relations – Hiking Route), we took the "symbol" attribute and we created a display style for each symbol / color of the marking. The other attributes of the relation are used to search or display additional information in the popup.

RESULTS AND DISCUSSION

As presented above, using the Mapbox GL library together with the free data available from OSM we implemented a map application called LaPlimbare dedicated to mountain tourism that displays useful information in these areas.

In addition to showing all the information that can be provided by a map, the application allows the transmission of other information that helps tourists avoid dangers and unforeseen situations.

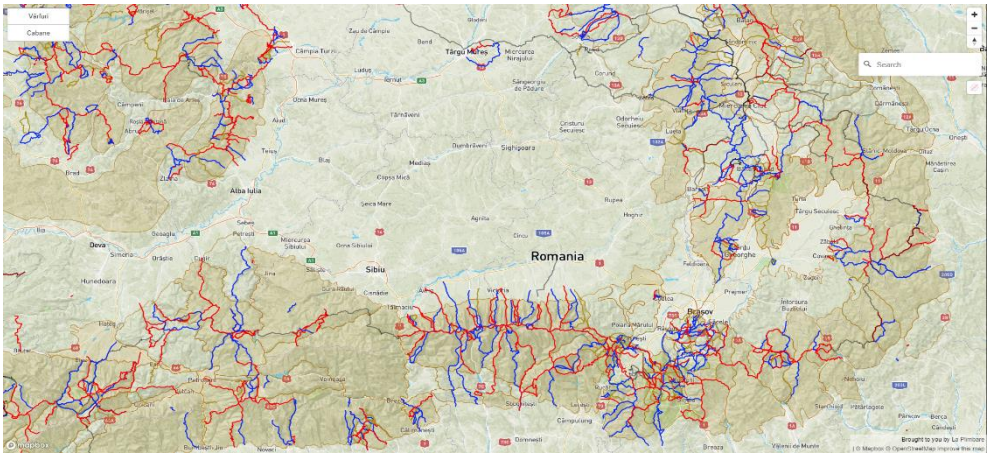

Fig. 2. The interface of the online map presented in the article

Source: https://laplimbare.ro/laplimbare/, data from openstreetmap.org

Figure 2 shows the initial interface of the online map. You can see the mountain areas marked in orange and the trails marked in the same color as the markings on the trail. In addition, the map contains a list of selectable points of interest and other buttons whose functionalities will be presented below.

To make the map we decided to achieve a number of important objectives and then continue with the secondary objectives. The main objectives are:

1. Display all the information needed to approach a mountain trail;
2. Filtering the information on the map and hiding / displaying the information of your choice;
3. Search for points of interest and display them;
4. Real-time location of the tourist on the map;
5. Useful additional information for all items displayed on the map.

Next we will present how these objectives were implemented.

1. Display all the information needed to approach a mountain trail

The map uses vector tiles technology and allows the information to be displayed selectively according to certain rules. In order to display only the useful information for those who approach a mountain route, we filtered the information from OpenStreetMap that can be displayed on the map. The basic information we considered on the initial map is:

- Tourist routes with the corresponding markings;
- Cabins, peaks and other points of interest useful for mountain tourism;
- Delimitation of mountain areas to allow the display of routes in a single area;
- Up-to-date information on all items displayed on the map.

As can be seen in Figure 3, the initial interface allows navigation in any of the mountain ranges in Romania and displays the marked trails in this massif.

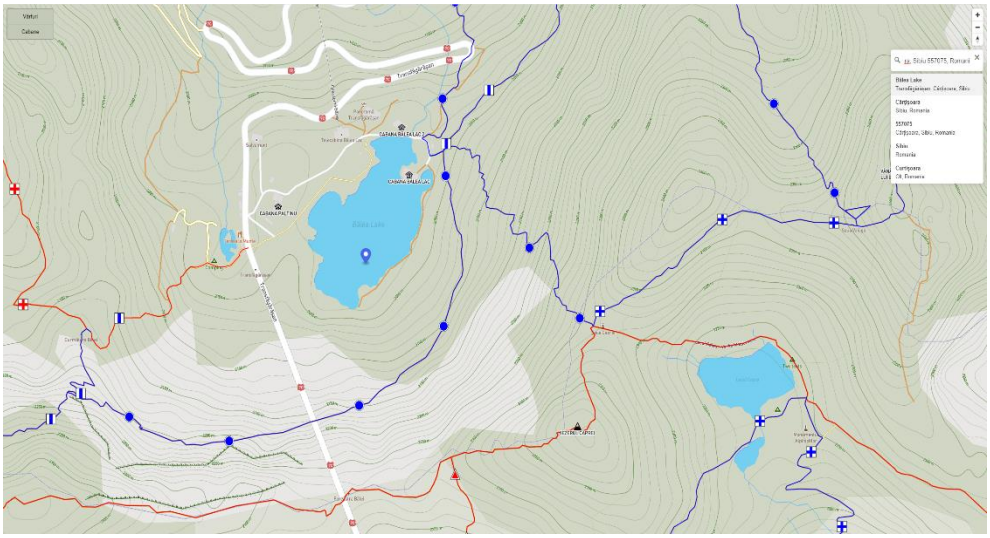

Fig. 3. Marked routes in Bâlea Lac area, Făgăraș Mountains
Source: https://laplimbare.ro/laplimbare/, data from openstreetmap.org

2. Filtering the information on the map and hiding / displaying the information at the user's choice of

Unlike image maps, vector tiles technology uses geometries and attributes for the elements displayed on the map. This allows the Mapbox GL library to show or hide various data on demand. We chose two thematic layers, the peaks and the cottages that we display only on request, as shown in Figure 3. Points of interest are highlighted on the map with some icons that provide strong contrast to the rest of the elements on the map to be easy to be found and identified.

3. Search for points of interest and display them

To make it easier to find information, any user of an interactive application needs a search function. The search function included in this application uses a geocoding library

also based on OSM data. Geocoding refers to finding coordinates on a map for a specific address or place name. There are several geocoding libraries available but for the current stage we used the geocoding library offered by Mapbox due to the fast integration with the map. The interface can be seen in Figure 3.

4. Real-time location of the tourist on the map

As mentioned in the introduction, classic maps are more suitable for general spatial knowledge of the area of interest. However, orientation and determining one's exact position on the classic map can create difficulties, especially in areas with low visibility.

In this situation, online interactive maps offer a major advantage: the phone's GPS knows its location.

The new geolocation standard (W3C, 2008) provides data on the position of a device such as latitude, longitude, altitude, speed and direction, as well as the accuracy. In the case of smartphones this location is obtained through the GPS device and has an accuracy of several meters.

Mapbox allows geolocation by means of a button that locates the user using the mentioned standard and displays its position and direction of movement on the map (Figure 4).

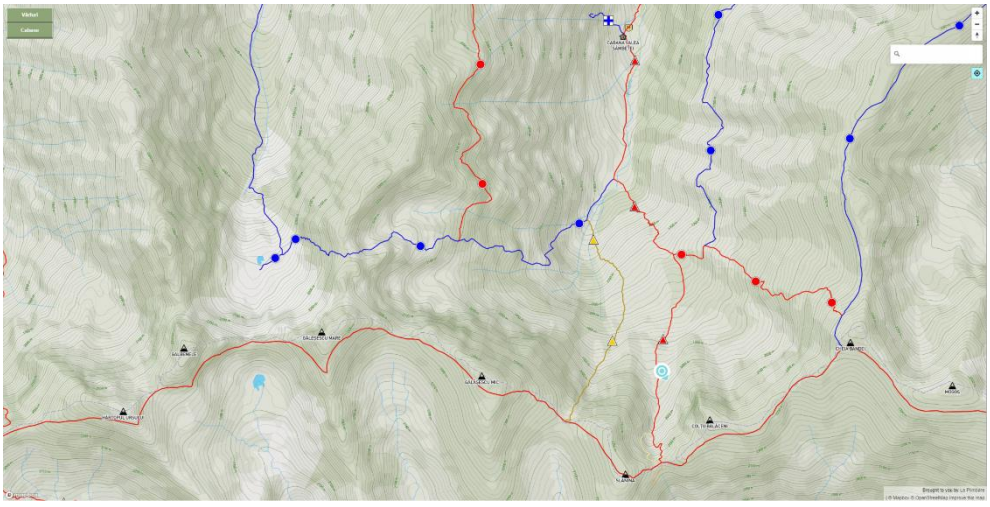

Fig. 4. Geolocation on the online map. Author: the author

Source: https://laplimbare.ro/laplimbare/, data from openstreetmap.org

Geolocation is one of the most useful map features offered by a smartphone and helps tourists have clear information about the surroundings of the place where they are. In case they get lost or encounter other dangers (accidents, blocked routes, etc.) they can use this function to reorient themselves or find the best solution to communicate where they are and avoid dangers.

5. Useful additional information for all items displayed on the map

Figure 5 shows how the additional information available in the OSM (Figure 1) can be displayed as a popup. With the development of the application this popup will contain more information or have a more functional and aesthetic style.

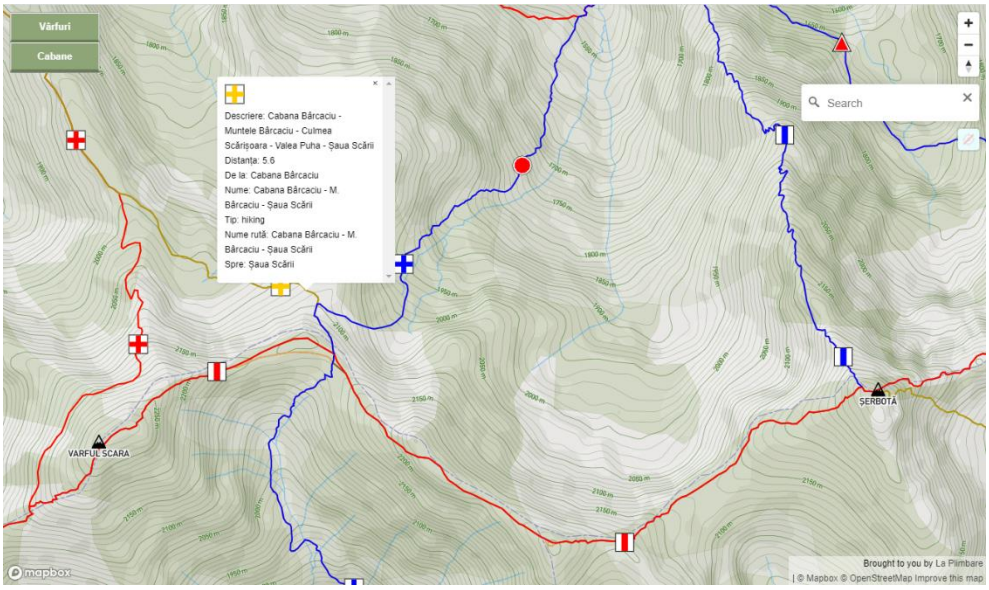

Fig. 5. Popup with route information. Author: the author

Source: https://laplimbare.ro/laplimbare/, data from openstreetmap.org

The pop-up displays data from the attributes of the OSM relationship that represent the route. Useful data is selected from those attributes and displayed in a structured way.

Information about these portions as well as about the entire route exists in the database. The vector tiles technology transmits for each element displayed on the map this metadata from which we managed to compile a popup with useful information. The data displayed in this area includes the route, marking, description of the objectives on the route and the distance to the nearest objective.

CONCLUSIONS AND POSSIBILITIES FOR FUTURE DEVELOPMENT

In its current form, the application offers tourists the opportunity to view mountain trails in the area where they are and get information about them. The fact that the application locates the user with a precision of a few meters if he has a GPS device helps with orientation, prevents tourists from getting lost and shows strictly what is of interest to the area where they are. The routes are constantly updated with the OpenStreetMap database so if a route is closed or modified tourists will have quick access to this information.

The most important limitation of the study is the impossibility to use the online map when no internet connection is available. The mountains have areas without GSM signal and a solution has to be found to store data on the user's device for usage

in these areas. Another limitation is given by the used data. We can add data representing more features that are important from tourists from OSM or after inutting it manually or obtaining it by spatial analysis on other datasets. There is no mapping application that gives all possible information and we need to have some users' input on what other data can be added.

In the future, we intend to add more types of additional information (sources, parking lots, campsites, shelters, risk areas, etc.) as well as to offer possibilities to filter the displayed information (for example highlighting a single route). The platform can also be extended to allow users to manually add useful information to other tourists, such as snow conditions in certain areas, rates or occupancy for cottages, blocked areas or any other type of information or warnings.

Another useful feature that we want to achieve is communication between tourists in the same area to obtain important information or plan trips on routes even if they do not know each other and do not have contact details.

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